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Selected US specifications from IPC sub-class F25B

(54) Modular fluidic heat exchange unit

(57) A fluidic heat exchange unit in modular form is provided and is capable of being interconnected to a further modular unit having the same height and depth, the length of the or each module being an integral multiple of a unit modular length to permit the heat exchange capacity to be varied by the interconnection of such units or by the exchange or removal of one or more of such units. As disclosed the units are refrigeration units.

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Fig.2

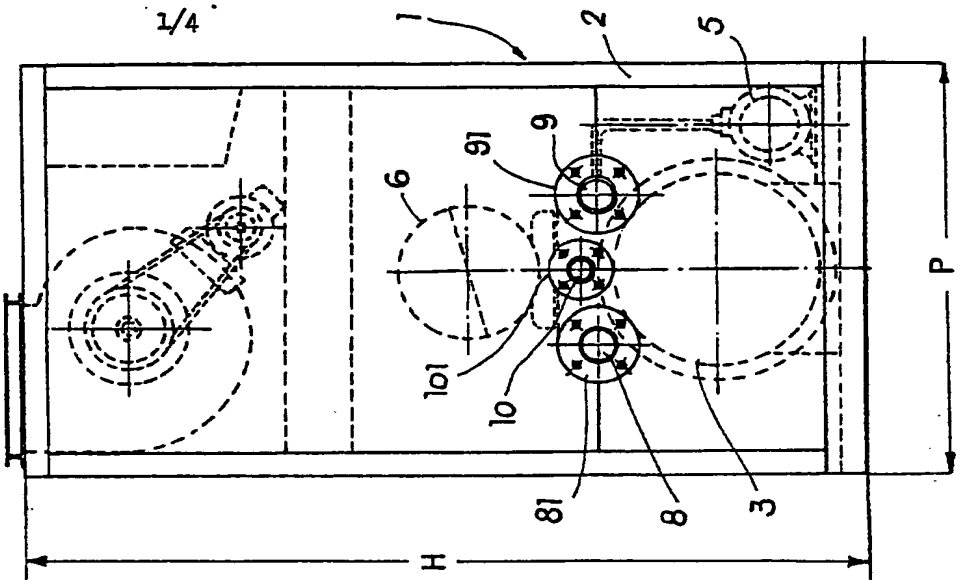


Fig.1

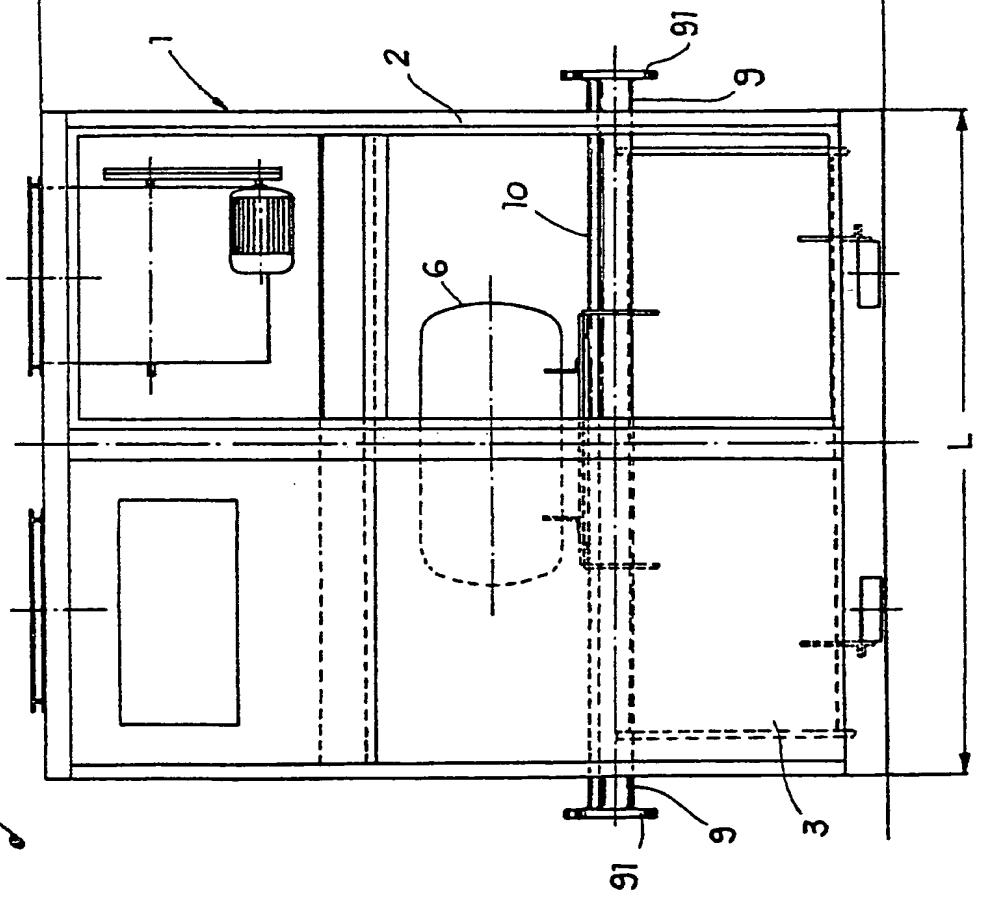


Fig. 3

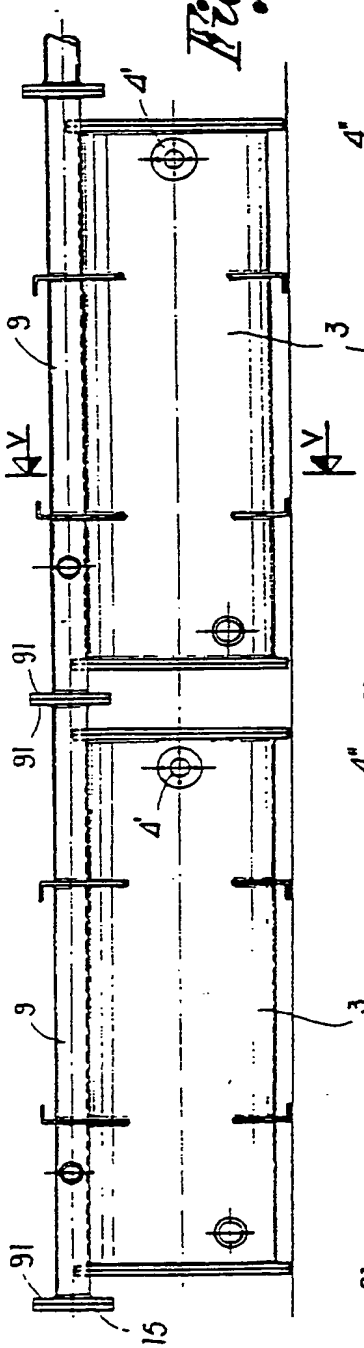


Fig. 4

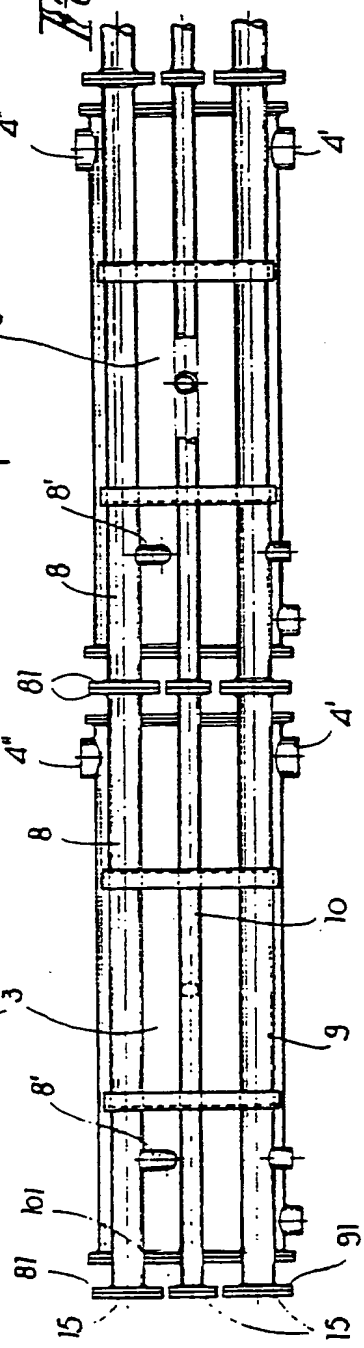
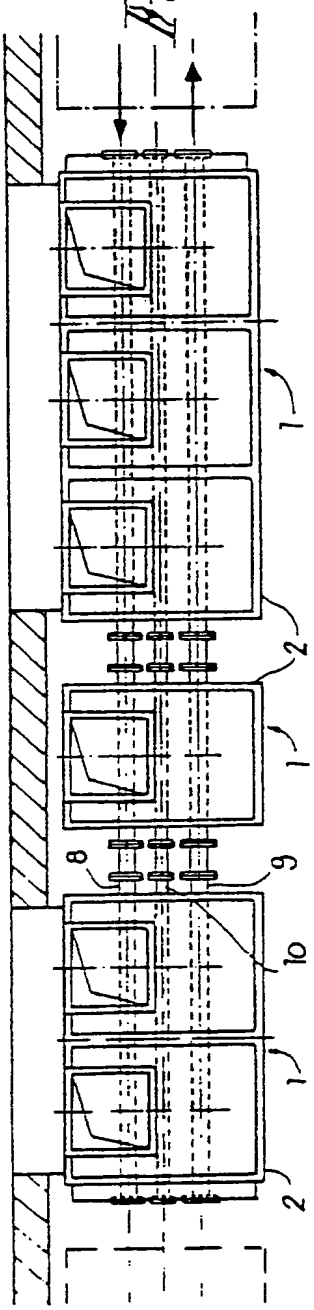


Fig. 6



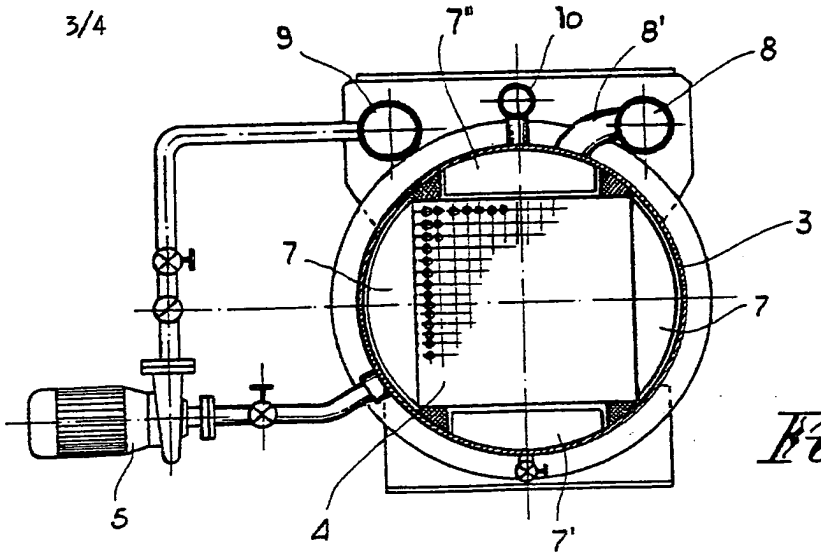


Fig.5

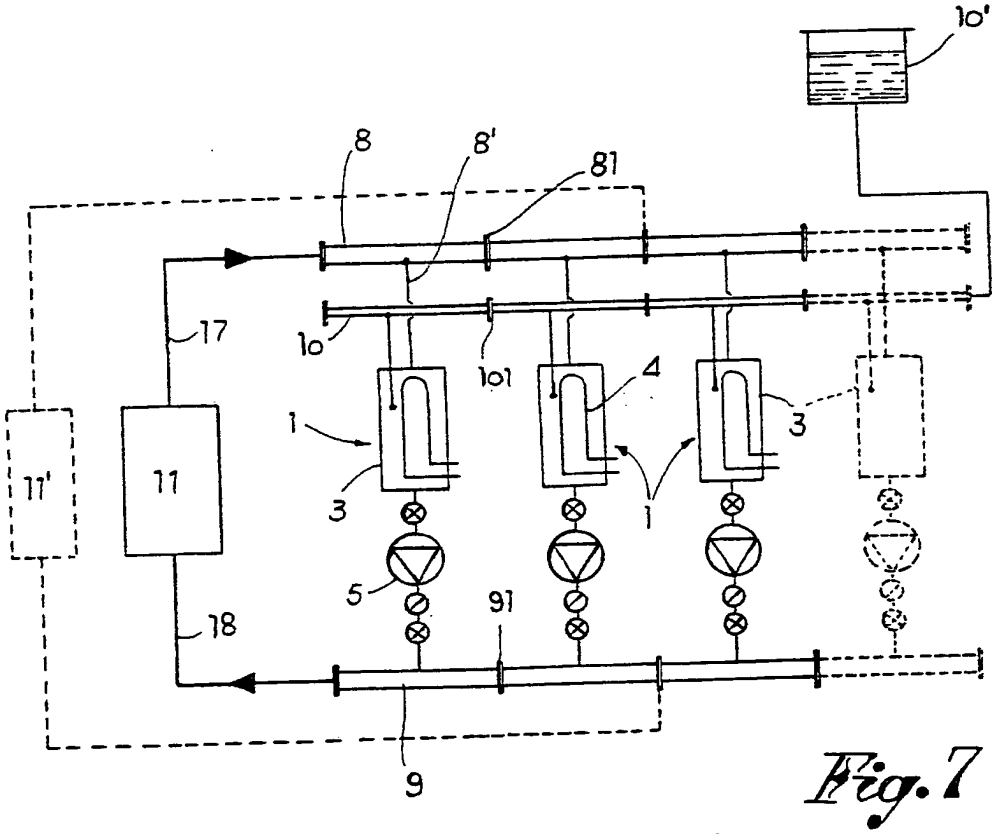


Fig.7

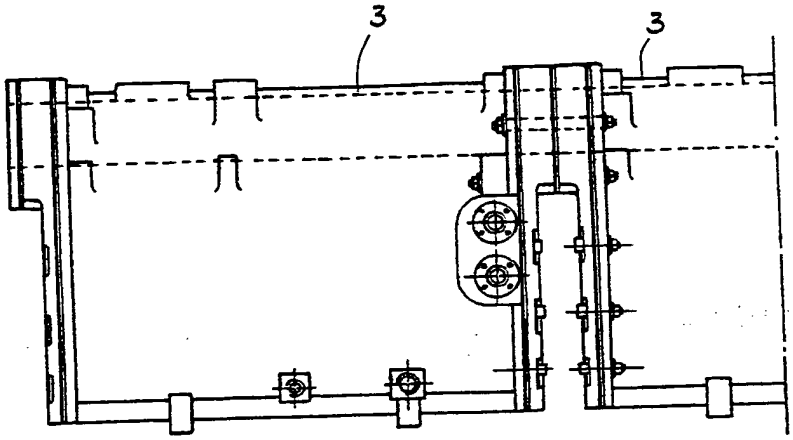


Fig.8

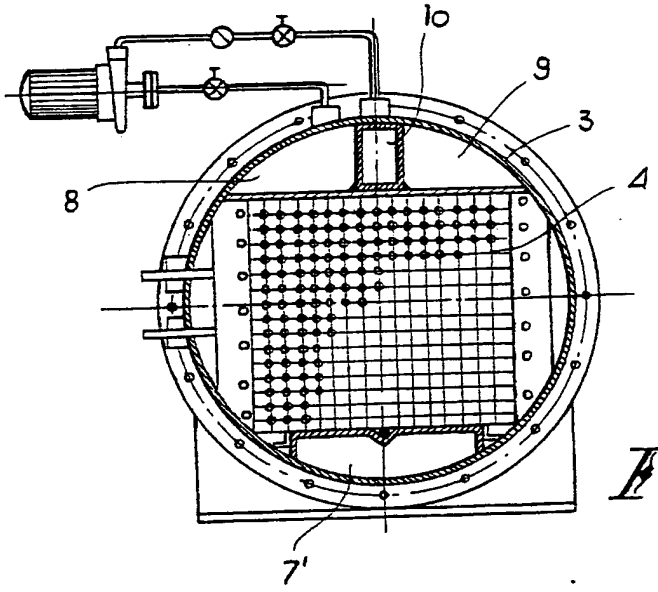


Fig.9

SPECIFICATION

Modular fluidic heat exchange unit

The present invention relates to a modular unit for fluidic heat exchange. More particularly, the invention relates to modular units which can be rapidly and easily interconnected to provide a heat exchange system of a desired size.

Devices known hitherto for the refrigeration of fluids of various types and for various purposes can be combined together as required in order to provide an appropriate refrigeration capacity. However, such apparatuses are not of true modular construction and the combination thereof cannot be achieved rapidly and efficiently.

At the present time, in fact, the modularisation of refrigerators for liquids is restricted to the combining of two or more identical units which are structurally independent, such units lack any complementary parts by means of which they may not only be mated together but also immediately functionally connected. The conduit connections need to be effected in situ by a skilled operative.

Very often, therefore, the conduit connections made in such a way are limited to the immediate requirements and must, therefore, be completely remade if, subsequently, the system needs to be enlarged or made smaller. In addition, connections made in situ also suffer from the disadvantage that, apart from the cost thereof, they are external of refrigeration equipment and the system produced is of relatively large dimensions and unnecessarily complex.

The present invention therefore seeks to provide a fluidic heat exchange system which does not suffer from these disadvantages. In particular, the present invention seeks to provide a unit for fluidic heat exchange which is effectively of modular construction and which permits the rapid combination of modular unit with similar units, which may be of different capacity, without the need for making special external conduit connections and which reduces the spatial requirements.

The invention further seeks to provide a fluidic heat exchange arrangement which can be assembled from modular units without the need for additional specialised work by specialised personnel by virtue of causing the conduit connections to be made directly and simultaneously with the mechanical connection of the units. This makes it possible to alter the capacity of the plant at any time simply by adding modular units thereto or removing units therefrom without needing to modify the modular units.

Certain embodiments of the present invention will be further described, by way of example, with reference to the accompanying drawings in which:

Figures 1 and *2* show, respectively, schematic front and side views of a refrigeration unit module in accordance with the present invention;

Figures 3 and *4* show, respectively, front and plan views of the conduits of two modules as shown in Figs. 1 and 2 connected in-line;

Figure 5 is a transverse cross-sectional view taken along the line V–V in Fig. 3;

Figure 6 shows a schematic plan view of a plurality of refrigeration unit modules of different capacities connected in-line;

Figure 7 shows, diagrammatically, the conduit arrangement in an assembly of interconnected modular refrigeration units, and

Figures 8 and *9* show, respectively, schematic front and side views of an alternative form of a refrigeration chamber.

Referring now to the drawings, particularly Figs. 1 and 2, there is shown a refrigeration unit module 1. A plurality, for example three, of versions of the unit module may be produced, which modules differ from one another in their ratings and in their effective refrigeration capacity. Each module may be used either as a separate and independent unit or may be connected to other modules 1 in order to form a composite refrigerator having a refrigeration capacity equal to the sum of the capacities of the individual modules.

In all circumstances, the refrigeration unit module 1 comprises a frame 2 of modular dimensions. Each module has a constant height H and a constant depth P, the different versions of the modules 1 only differing from one another in respect of their length L. However, the length of each module is an integral multiple of the length of the smallest module 1.

Thus, purely as an example, each unit 1 may have a height H of 2110 mm, a depth P of 1110 mm and a length L of 900 mm, 1800 mm or 2700 mm depending on the intended capacity of the unit.

Irrespective of its capacity, each refrigeration unit module 1 includes conventional refrigeration devices which require no further description. These devices include a closed cylindrical chamber 3 which is disposed with its major axis extending horizontally. An evaporator 4 and its associated pump 5 and a compressor 6 are disposed within the chamber 3. The evaporator 4 is fed with refrigeration fluid through an inlet and an outlet 4′ and 4″ respectively and is centred within the chamber 3 so as to define two lateral chambers 7 for the circulation of fuid, a lower chamber 7′ for the collection and evacuation of dirt and other kinds of deposits, and an upper chamber or conduit 7″ which feeds and passes the fluid to be cooled to the top of the evaporator 4.

Externally of the chamber 3, either above, below or laterally thereof, are provided a plurality of conduits which extend parallel to one

another and which are used for circulating coolant fluid to and from the evaporator 4. More specifically, three such conduits are provided which comprise a conduit 8 for passing the fluid to be cooled into the chamber 3, a conduit 9 for returning the cooled fluid towards an external device (as shown in Fig. 7) and a vent and safety conduit 10. The supply conduit 8 communicates, by means of at least one branch conduit 8', with the interior of the chamber 3 and, more specifically with the distribution chamber 7" thereof. The return conduit 9 is connected to the outlet or delivery side of a pump 5, the inlet of which is connected through the intermediary of a suitable valve or valves to the chamber 3. As shown, this connection is to one of chambers 7 through which the fluid is circulated. In turn, the vent conduit 10 connects the chamber 7" of the chamber 3 to an expansion vessel 10'.

The conduits 8 and 9 have cross-sections which permit the circulation of the fluid to be cooled even if a plurality of unit modules are interconnected to form a refrigerator of large capacity. In addition, the conduits 8, 9 and 10 are of such a length that they project beyond the opposite ends of the chamber and from the side of the frame 2. Flanges 81, 91 and 101 or joints (not shown) are provided at the ends of the conduits to permit the rapid in-line connection of two or more refrigeration unit modules, as is shown in Figs. 3, 4 and 6.

If a unit 1 is to be used independently, that is to say, if it is not connected to any other units, or if it is the end unit of a plurality of units, one end of each pipe 8, 9 and 10 is closed off by means of, for example, an end flange 15 which is bolted to the appropriate flange 81, 91 or 101. The other ends of the conduits 8 and 9 are connected to conduits 17 and 18 which respectively constitute the outlet from and the inlet into an external device 11 for which the fluid has been cooled, as shown in Fig. 7. The vent conduit 10, on the other hand, is connected to the expansion vessel 10'.

The in-line connection of a plurality of refrigeration unit modules 1 is achieved by attaching together the projecting and mating flanges 81, 91, 101 adjacent units as can be seen in Figs. 3 and 4. The manner of achieving this connection is to insert seals between the flanges and then to bolt the flanges together. When the units 1 has been interconnected their conduits 8, 9 and 10 are in communication with one another and the fluid to be cooled is circulated by being delivered from the device 11 along the conduit 17 and, after cooling, is returned by the action of pump 5 to the device 11 through the conduit 18.

As a result of this modular construction of the units 1, refrigeration unit modules of the same or different capacities can be easily and quickly connected together to provide a composite refrigeration unit of the desired capacity. Examples of the connection of a plurality of modular units are illustrated in Figs. 6 and 7 in which like reference numbers are used to indicate like parts.

As stated hereinbefore and as shown in Figs. 5, 6 and 7, the inlet to pump 5 in each unit is connected, through the intermediary of appropriate valves to the chamber 3 whilst the outlet or delivery side of the pump is connected to the conduit 9 for appropriate circulation of the fluid which is to be cooled.

In practice, the fluid to be cooled and which originates from the device 11 is passed through the return conduit 17 into the conduit 8 from which it passes, through branch conduit 8' into the circulation chamber 7 of the chamber of each refrigeration unit and thence to the heat exchanger or evaporator 4.

The fluid is cooled in the evaporator 4 and, on leaving the latter, is collected in the circulation chamber 7 of the refrigeration chamber 3. It is removed therefrom by the pump and passes through the conduit 18 back to the device 11, thus completing the closed circuit.

The refrigeration units described hereinbefore can, of course, be modified without departing from the scope of the present invention. Thus, for example, as shown in Figs. 8 and 9, the conduits 8, 9 and 10 may be constructed within the chamber 3 so that a plurality of units may be aligned with one another and interconnected.

The modular units can also be used in plants of different kinds and also offers the possibility of connection to other units in various arrangements other than the in-line arrangement described hereinbefore. Such arrangements can be achieved rapidly and easily with the minimum use of space.

In fact, if further conduits are connected to the conduits 8 and 9, in the context of two adjacent units, branches can be provided for other external devices 11' as shown by the dashed lines in Fig. 7. Total flow of cooled fluid which is well above the capacities of the conduits can be delivered in this way with the advantage of the possibility of constructing long circuits without the need for using large diameter conduits.

Finally it should be noted that if a condenser is located in the chamber 3 instead of the evaporator 4, the unit described may be used for heating of fluids without affecting the modular construction or the possibility of assembly with other modular units.

CLAIMS

1. A fluidic exchange unit in modular form capable of being interconnected to a further modular unit having the same height and depth, the length of the or each module being an integral multiple of a unit modular length to permit the heat exchange capacity to be varied by the interconnection of such units or by the exchange or removal of one or more of

such units.

2. A heat exchange unit as claimed in claim 1, comprising a chamber having its major axis disposed horizontally, the chamber having a length equal to the length of the module, an evaporator or a condenser disposed within the chamber and connected to a compressor and to a pump, and conduit means for the circulation of the fluid to and from the evaporator or condenser extending over the entire length of the chamber.

3. A heat exchange unit as claimed in claim 2 wherein the conduits for circulation of the fluid which is to be subjected to heat exchange extend externally of but parallel to the major axis of the chamber, the conduits being fitted with end flanges or joints for the direct in-line connection thereof to corresponding conduits or other modular units.

4. A heat exchange unit as claimed in claim 3, wherein two primary laterally disposed, longitudinally extending chambers for the circulation of the fluid, a third lower chamber for the collection and evacuation of dirt or deposits for disposal and a fourth upper chamber for delivery and distribution of the fluid being treated are formed in the horizontally disposed chanmber, one of the conduits being connected to said upper chamber of the tank and to a unit from which the fluid to be heat exchanged emanates through the intermediary of first auxiliary conduit, a second of the conduits being connected, through the intermediary of a pump to at least one of said laterally disposed chambers and, through the intermediary of a second auxiliary conduit, to the unit which is to be supplied with the heat-exchanged fluid and a third of the conduits being connected to said lower chamber and to an expansion vessel.

5. A heat exchange unit as claimed in claim 1 or 2, wherein the conduits for the circulation of the fluid requiring heat exchange are constructed within the horizontally disposed chamber.

6. A heat exchange unit as claimed in claim 1 constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

7. A heat exchange array comprising a plurality of interconnected modular units as claimed in claim 1 wherein the conduits in each modular unit are provided with end flanges which are interconnected to one another so as to produce continuous conduits.

8. A heat exchange array comprising a plurality of interconnected modular units as claimed in claim 5.

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